Agriculture College – Wasit University

Dijlah Journal of
Agricultural Sciences

ISSN 2790 – 5985
eISSN 2790 – 5993

Dijlah J. Agric. Sci.، 3(1):18-30, 2025

# Impact of Mineral Fertilizer (NK) and Gibberellic Acid (GA3) Spraying on the Development and Yield of Various Wheat Cultivars in the Central Region of Iraq

**Hanan Salah Mahdee**

**Kirkuk university - College of Agriculture**

Corresponding author: hanansalah@uokirkuk.edu.iq

## Abstract:

During the growing season of 2021–2022, an experiment was carried out in central Iraq's Al-Qadisiyah province to find out how productive the wheat crops Baghdad 3, Babylon 113, and Al-Furat were when they were fertilized with gibberellic acid and macro elements. The recommended fertilizers were 20 kg ha-1 of triple superphosphate and 156 kg ha-1 of urea. Three different types of fertilization were used: T1 was a control treatment, T2 had 75 mg L-1 of gibberellic acid at a concentration of macro elements, and T3 had 150 mg L-1 of gibberellic acid at a concentration of mono and dilute elements. The data indicate that 425 mm of water is used during the year. Gibberellic acid and a fertilizer mixture (balanced mineral fertilizer and microelements) sprayed onto plants at various growth phases produced noticeable changes in spike length, leaf area, and plant height. In this experiment, the integrated fertilizer combination of gibberellic acid, triple superphosphate fertilizer (20 kg ha-1), and urea fertilizer (156 kg ha-1) was successful in spraying microelements, nitrogen, and potassium before planting. The overall wheat yield in the Baghdad 3 cultivar was (3900 kg ha-1 and 3664 kg ha-1) after T2 with T3 fertilization treatments, respectively, compared to 2664 kg ha-1 after T1 treatment. Comparing the Babylon113 cultivar to one treated with T1 fertilization (2500 kg ha-1), the weight of the overall yield rose with fertilization treatments T2 (3664 kg ha-1) and T3 (3920 kg ha-1). Total wheat yield rose from (1832 kg ha-1) with treatment T1 to (2500 kg ha-1) and (3460 kg ha-1) with fertilization treatments T2 with T3, in the Al-Furat cultivar.

**Keywords***:* *gibberellic acid, foliar spraying of Macro and Micro elements, wheat cultivars*

**Received: 20/11/2024** **Accepted: 2/1/2025** **Published: 19/1/2025**

# تأثير الرش بحامض الجبريليك (GA3 ) والسماد المعدني (NK) في نمو وانتاجية أصناف مختلفة من الحنطة في المنطقة الوسطى من العراق

**حنان صلاح مهدي**

كلية الزراعة/ جامعة كركوك

## الخلاصه:

نفذت تجربة حقلية خلال الموسم الزراعي 2021-2022 في وسط العراق متمثلة بمحافظة القادسية/ محطة أبحاث النورية لتحديد انتاجية محصول الحنطة صنف بغداد 3 وبابل 113 والفرات من التغذية أو التسميد الورقي لحامض الجبرليك والعناصر الكبرى بتوصية سمادية (سماد سوبر فوسفات الثلاثي قبل الزراعة 20 كغم هكتار-1 ، سماد اليوريا 156 كغم هكتار-1)، استخدمت ثلاث معاملات للتسميد T1 وT2 وT3 ، والري عند استنفاد 55% من الماء الجاهز. زرعت الوحدات التجريبية بمحصول الحنطة Triticum aestivum L. صنف بغداد 3 بتاريخ 2021/12/2 بمعدل بذار 140 كغم هكتار-1. أجريت جميع عمليات خدمة المحصول يدوياً وبصورة دورية خلال موسم النمو بأكمله وحصدت النباتات بتاريخ 2022/5/12.

أظهرت النتائج أن الاستهلاك المائي الموسمي 425 مم. وإن الرش بحامض الجبرلين والتوليفة السمادية (السماد المعدني المتوازن والعناصر الصغرى) خلال مراحل النمو المختلفة حققت فروقا معنوية في ارتفاع النبات والمساحة الورقية وطول السنبلة. وبينت نجاح التوليفة السمادية المتكاملة لرش النايتروجين والبوتاسيوم والعناصر الصغرى بوجود حامض الجبرليك مع تسميد ارضي بسماد سوبر فوسفات الثلاثي قبل الزراعة 20 كغم هكتار-1، وسماد اليوريا 156 كغم هكتار -1 تحت ظروف التجربة الحالية.

بينت النتائج إن حاصل الحنطة الكلي (3900 كغم هكتار-1) و(3664 كغم هكتار-1) عند معاملة التسميد T2 وT3 على الترتيب مقارنة بمعاملة T1 عند الصنف بغداد 3. اما عند الصنف بابل 113 فقد ازداد وزن الحاصل الكلي مع معاملات التسميد T2 و T3 قياسا بمعاملة لتسميد T1 . وعند الصنف فرات فقد ازداد حاصل الحنطة الكلي مع معاملات التسميد T2 و T3 قياسا بمعاملة T1.

**الكلمات المفتاحية**: حامض الجبرليك، الرش بالعناصر الصغرى والكبرى، اصناف الحنطة.

## Introduction

Triticum aestivum L. is an annual plant classified in the Poaceae family. It is a very significant and extensively cultivated cereal crop, and it has a prominent position as a staple food source for humans. It is used mainly as food and feed, and presently, the globe, including nations such as Iraq, is confronting an unparalleled challenge to enhance agricultural productivity to ensure food security for a population of 33 million humans, according to estimates by the Food and Agriculture Organization. To attain food security, Iraq must enhance its output in the upcoming years. To accomplish this enormous task there must be special attention to soil management such as tillage, water management and nutrient management, and for the rising population in Asia, the production of food grains must be increased by 1.2% to 1.5% annually to meet the growing demand and to ensure food security (Kumar et al., 2018; Ati et al., 2018; Ati et al., 2021; Mahdee et al., 2023).

Nutrition of the plant through the leaves is an effective way to better transfer nutrients within the plant and increase production in quantity and quality. Growth regulators are an agricultural biological chemical technique that allows plants to absorb nutrients more effectively and maximize their physiological and genetic capacities. Growth regulators also activate agricultural component production processes by influencing plant growth and development. Gibberellins are one of the plant growth regulators known to have a growth-stimulating effect, and gibberellins have an important role in stimulating many physiological responses in many plants. It promotes vegetative development by boosting cell elongation and number, resulting in an increase in all plant physiological manifestations. Gibberellins play an important and distinct role without other hormones within plant tissues in terms of growth and maturity even in biological processes and chemical reactions under a special enzymatic system in plants (Al-Ghanimy, 2015). The National Wheat Agriculture Improvement Program in Iraq's staff was forced to adopt agricultural technologies related to foliar feeding, balanced mineral fertilization, irrigation, and agricultural methods to keep up with the growing demand for wheat grain. In particular, the use of plant hormones, such as gibberellic acid, which serves as a regulator and stimulant for plant growth, was one of the technologies they adopted. As well as the importance of balanced mineral fertilizer NPK for its role in increasing plant vitality and reducing chemical mineral fertilizers with the high cost of ground additives and working to reduce pollution resulting from their use, based on the above. The research is to investigate the impact of applying gibberellic acid and balanced mineral fertilizer on the development and productivity of different wheat types in the central area of Iraq.

## Material and Methods

An agricultural study was carried out in the 2021-2022 season in the Iraqi central area, specifically in Al-Qadisiyah province at the Al-Nouriah Research Station. The objective was to assess the yield of three wheat varieties (Baghdad 3, Babylon 113, and Al-Furat) when treated with gibberellic acid and macro elements through foliar fertilization. The recommended fertilization regimen included the application of triple superphosphate fertilizer at a rate of 20 kg per hectare before planting, as well as urea fertilizer at a rate of 156 kg per hectare. The soil was measured and analyzed using the conventional procedures described in references (Black,1965 and Page et al., 1982) (Table 1). A moldboard plow tills the soil. Following that, the field is leveled using a laser and then split into plots. Each plot has an area of 30 m2, with a gap of 1.5 m between adjacent plots and a gap of 2 m between replicates. This spacing is intended to limit the lateral flow of water between plots. On 2/12/2021, The wheat crops of Triticum aestivum L. Baghdad 3, Babylon 113, and Al-Furat were seeded at a rate of (140 kg ha-1 ) in the experimental units. All crop treatment activities were carried out manually and on a regular basis during the growth season, with the plants harvested on December 5, 2022. The Split Plot Design was employed in accordance with the Randomized Complete Block Designs, with three replications.

The cultivars used in the main plots were Baghdad 3, Babylon 113, and Al-Furat, whereas the sub-plots were filled with gibberellic acid spray and balanced mineral fertilizer. Gibberellic acid was prepared by dissolving GA3 powder with distilled water at concentrations of (0, 75, and 150 mg L-1) using a backpack sprayer. Spraying operations were conducted in the early morning at the specified spray time, resulting in 27 experimental units (three fertilizer treatments, three cultivars, and three replicates). The data were statistically analyzed using (SAS,2018) and the means were compared using the least significant difference (LSD) test with a significance level of 5%. The study encompassed the subsequent fertilizer treatments:

| No | sprayingdate (a day After germination) | Treatments | Fertilization |
|---|---|---|---|
| T1 | 0 | control | The experimental land was fertilized with chemicalfertilizers at the rate of 200kg $P_2O_5$ $ha^{-1}$ in the form of DAP ($P_2O_5$ 46%) before planting, and Nitrogen fertilizer 200 kg $ha^{-1}$ by adding urea N 46% in threetimes, the first after two week germination and the second and three after 40 and 80 days of planting |
| T2 | 20 | Gibberellic acid at a concentration of 75 mg $L^{-1}$ + (1/2 Fertilizer recommendation followed in control treatment) | Gibberellic acid is spraying after dissolving $GA_3$ powder with distilled water at a concentration of75 mg $L^{-1}$ |
| | 40 | | Gibberellic acid is spraying after dissolving GA3powder with distilled water at a concentration of 75 mg $L^{-1}$ |
| | 60 | | To spray 3000 mg N $L^{-1}$ (urea as a source of nitrogen 46% N) + 4500 mg K $L^{-1}$ (potassium sulfate fertilizer 41% K) |
| | 80 | | Spray microelements (program combination Fe, Zn, Cu, Mn) at an average of 800 g ha-1 |
| | 100 | | To spray 3000 mg N $L^{-1}$ (urea as a source of nitrogen 46% N) + 4500 mg K L-$^{1}$(potassium sulfate fertilizer 41% K) |
| | 120 | | Spray microelements (program combination Fe, Zn, Cu, Mn) at an average of 800g $ha^{-1}$ |
| T3 | 20 | Gibberellic acid at a concentration of 150 mg $L^{-1}$ +(1/2Fertilizer recommendation followed in control treatment) | Gibberellic acid is spraying after dissolving GA3 powder with distilled water at a concentration of 150 mg $L^{-1}$ |
| | 40 | | Gibberellic acid is spraying after dissolving GA3 powder with distilled water at a concentration of 150 mg $L^{-1}$ |
| | 60 | | To spray 3000 mg N $L^{-1}$ (urea as a source of nitrogen 46% N) + 4500 mg K $L^{-1}$ (potassium sulfate fertilizer 41% K) |
| | 80 | | Spray microelements (program combination Fe, Zn, Cu, Mn) at an average of 800 g $ha^{-1}$ |
| | 100 | | To spray 3000 mg N $L^{-1}$ (urea as a source of nitrogen 46% N) + 4500 mg K $L^{-1}$ (potassium sulfate fertilizer 41% K) |
| | 120 | | Spray microelements (program combination Fe, Zn, Cu, Mn) at average of 800 g $ha^{-1}$ |

**Table 1. Field soil physical and chemical parameters before planting**

| **Properties** | **Units** | **0-30 m** |
|---|---|---|
| Sand | gm kg soil$^{-1}$ | 232 |
| Silt | | 660 |
| Clay | | 108 |
| **Soil Texture** | | Silt loam |
| Bulk density | µg m$^{-3}$ | 1.42 |
| Volumetric moisture content at 33 kPa | cm$^{3}$cm$^{3}$ | 0.241 |
| Volumetric moisture content at 1500 kPa | | 0.171 |
| Electrical conductivity EC 1:1 | dS m$^{-1}$ | 4.77 |
| pH | | 7.81 |
| Organic Matter | g kg$^{-1}$ | 6.90 |
| $CaCO_3$ | | 298 |
| available nitrogen | mg kg$^{-1}$ | 21.00 |
| available phosphorous | | 11.76 |
| available potassium | | 295 |

The irrigation procedure was initiated once 55% of the available water had been used up, with the irrigation water having an electrical conductivity of 3.6 dSm-1. This irrigation was carried out for the 0-0.2 m layer from the time of planting to the vegetative growth stage. Gravimetric methods are used to determine soil moisture content. To regulate the quantity of water added to address moisture deficiency in each treatment, 3 inch plastic tubes and a water meter link were employed. The quantity of water required to offset moisture loss was computed using (equivalent 1). (Allen et al., 1998), while the seasonal water requirement was determined based on the water equilibrium equation equivalent 2 .(

Since: -

$$d=\left(\theta_{fc}-\theta_{w}\right)\times D ..........(1)$$

d= depth of water sdded (mm)

Ɵfc= Volumetric Humidity at Field Capacity

Ɵw = volumetric moisture before irrigation

D = soil depth at effective roots (mm)

(I+P+C) – (ETa+D+R) = $\triangle$S ............ (2)

Since:

I = depth of irrigation water added (mm

P = rainwater depth (mm.(

C = capillary height of water (mm), assuming it is zero because the groundwater is deep

ETa= actual evaporation transpiration (mm

D = depth of puncture water (mm) assuming zero because deep leaching losses are 0

R = runoff (mm) assuming 0

$\Delta$S = change in soil moisture storage between the beginning and end of the season.

For every experimental treatment, field characteristics of wheat yield were assessed. After flowering was finished According to (Thomas,1975), and equation (Equation 3), from each experimental unit, ten plants were chosen from the center. to measure their height (in centimeters) and the area of their flag leaves (cm$^2$plant$^{-1}$).

the flag leaf Area = length of the leaf x width of the leaf from the widest area x 0.95 (3)

The average spike length (cm) from the base of the spike to the end of the terminal spike without the sap for each experimental unit .It was measured at full maturity. A seed counter was used to pick 1000 grains at random from the grain yield of each experimental unit. Subsequently, the weight of each sample was measured for every experimental unit. The grain yield was calculated by harvesting one square meter of guarded lines from each experimental unit, then it was converted to kg ha$^{-1}$.

## Results and Discussion

### Total Water Consumption

Table 2 shows the seasonal water consumption, irrigation water amount, and number of irrigations for full irrigation treatments—that is, when 55% of the available water is used up, across the whole season. The water usage during the specific season reached a total of 425 mm, despite the very low rates of rainfall. However, the climatic data parameters were very suitable from the temperatures and relative humidity rates in that agricultural season. It is noted that these values are much less than (Jabbar et al., 2020 and Mahmoud et al., 2024) the results of experiments conducted in central Iraq, which amounted to 446-510 mm, and another research amounted to 600 mm.

**Table 2.** Water Balancing Factors for Wheat Crop

| Location | number of irrigations | Rainwater Depth (mm) | Irrigation Water Depth (mm) | Water consumption ETa (mm) | Amount of water used (m$^3$/ha) |
|---|---|---|---|---|---|
| Al-Qadisiyah | 12 | 6.4 | 418.6 | 425 | 4250 |

## Vegetative Growth Properties

### 1.Plant Height (cm)

Table (3) displays the impact of applying gibberellic acid and a mixture of balanced mineral fertilizer and microelements at various growth stages on the height of the plant (measured in centimeters). Significant variations in average plant height have been observed due to the application of gibberellic acid at various dosages in conjunction with fertilizer. The T3 treatment outperformed the T2 and T1 treatments by producing the tallest average plant height of (102.28 cm), representing an increase of (7.17% and 28.67%) respectively. Furthermore, the T2 therapy outperformed the T1 treatment with a notable increase of (20.07%). There are also big changes between the average plant heights under the different cultivar treatments, as shown in the table. The Al-Furat cultivar had the highest average plant height, measuring (104.81 cm). The lowest value in the cultivar Baghdad 3 was (84.39 cm), and the percentage increase was (24.20 and 4.39%) for the Al-Furat and Babylon 113 cultivars, respectively, compared to the Baghdad 3It was seen that the fertilization treatments T2 and T3 were much better than the treatment T1 in all cultivars. For example, the Baghdad 3 cultivar had values of (70.11 cm, 89.71 cm, and 93.34 cm) for T1, T2, and T3 fertilization, while the Babylon cultivar had values of( 87.23 cm, 91.50 cm, and 94.31 cm) for T1, T2, and T3 fertilization, the Al-Furat cultivar exhibited measurements of (90.13 cm, 105.11 cm, and 119.20 cm) for the T1, T2, and T3 fertilization treatments, respectively.

**Table 3.** Effect of spraying with gibberellic acid and balanced mineral fertilizer on plant height (cm)

| **Fertilization treatments** | **Bagdad 3** | **Babylon 113** | **Al-Furat** | **Mean** |
|---|---|---|---|---|
| **$T_1$** | 70.11 | 78.23 | 90.13 | 79.49 |
| **$T_2$** | 89.71 | 91.50 | 105.11 | 95.44 |
| **$T_3$** | 93.34 | 94.31 | 119.20 | 102.28 |
| **Mean** | 84.39 | 88.01 | 104.81 | |
| **LSD (0.05)** | 2.88 = cultivar<br>4.71 = Fertilization treatments<br>6.11 = Fertilization treatments × cultivar | | | |

Table (4) displays the impact of applying gibberellic acid and a mixture of balanced mineral fertilizer and microelements at various growth stages on the leaf area (cm2). It is observed that the mean leaf surface area varies significantly to the impact of spraying gibberellic acid at varying levels in conjunction with the fertilizer combination. The largest mean leaf area was for T3 treatment which give 67.25 cm2.A 7.72% and 145.17% increase from the T2 and T1 treatments. The T2 treatment also outperformed the T1 treatment, with a 126.22% increase (Ati et al., 2024). The table indicates notable disparities in the average leaf area values among the different cultivar treatments, as the highest value of the leaf area was in the cultivar Al-Furat, which amounted to 55.46 cm2, and the lowest value was in the cultivar Babylon 113, which amounted to 50.42 cm2, and the percentage increase was 10.06% and 8.26% for the cultivars Babylon 113 and Baghdad 3, respectively, compared to the Al-Furat cultivar and when the two interactions ,the fertilization treatments T2 and T3 outperformed treatment T1 in all cultivars, when the cultivar Baghdad 3 reached 21.62, 64.35 and 67.72 cm2 for the fertilization treatments T1, T2 and T3 respectively and for the cultivar Babylon 113, it reached 23.44, 62.67 and 65.16 cm2 for the fertilization treatments T1, T2 and T3, respectively. And for the cultivar Al-Furat, it reached 37.23, 60.28 and 68.46 cm2 for the fertilization treatments T1, T2 and T3 respectively.

**Table 4.** Effect of spraying with gibberellic acid and balanced mineral fertilizer on leaf area ($cm^2$)

| **Fertilization Treatments** | **Bagdad 3** | **Babylon 113** | **Al-Furat** | **Mean** |
|---|---|---|---|---|
| **$T_1$** | 21.62 | 23.44 | 37.23 | 27.43 |
| **$T_2$** | 64.35 | 62.67 | 60.28 | 62.43 |
| **$T_3$** | 67.72 | 65.16 | 68.88 | 67.25 |
| **Mean** | 51.23 | 50.42 | 55.46 | |
| **LSD (0.05)** | 2.34 = cultivar<br>7.15 = Fertilization treatments<br>12.11 = Fertilization treatments × cultivar | | | |

Table (5) displays the impact of applying gibberellic acid and the spike length (cm) was measured after applying a combination of well-balanced mineral fertilizer and microelements throughout different growth stages. It is observed that the effects of spraying gibberellic acid at varying amounts with the fertilizer mixture result in notable variations in the average spike length (Al-Mohammedi et al., 2019; Dawod ET AL., 2024). Compared to treatments T2 and T1, T3 treatment outperformed with the largest average spike length of 16.67 cm, an increase of 3.73% and 62.95%, respectively, while T2 therapy outperformed T1 treatment with an increase of 57.09%. Also demonstrates that there are significant differences in the average spike length values under the cultivar treatments. The Babylon 113 cultivar had the highest spike length value, measuring 16.75 cm, while the Al-Furat cultivar had the lowest value, measuring 13.31 cm. The Babylon cultivar also had the lowest spike length value, with an increase rate of 25.85%, while the Al-Furat cultivar had the lowest value. 113 and Baghdad 3, respectively, compared to Al-Furat cultivar. When the two interactions were observed, the fertilization treatments T2 and T3 were significantly excelled compared to the treatment of T1 in Baghdad 3 cultivar reached 10.67, 16.88 and 20.21 cm for the T1, T2 and T3 fertilization treatments, respectively and in the Babylon 113 cultivar, it reached 11.12, 17.87 and 21.25 cm for the fertilization treatments T1, T2 and T3 respectively. And at the Al-Furat cultivar, it was 8.91, 13.45 and 17.56 cm for the T1, T2 and T3 fertilization treatments, respectively.

**Table 5.** The effect of spraying with gibberellic acid and a balanced mineral fertilizer on the spike length(cm)

| Fertilization Treatments | Bagdad 3 | Babylon 113 | Al-Furat | Mean |
|---|---|---|---|---|
| **$T_1$** | 10.67 | 11.12 | 8.91 | 10.23 |
| **$T_2$** | 16.88 | 17.87 | 13.45 | 16.07 |
| **$T_3$** | 20.21 | 21.25 | 17.56 | 16.67 |
| **Mean** | 15.92 | 16.75 | 13.31 | |
| **LSD (0.05)** | 0.87 = cultivar<br>1.12 = Fertilization treatments<br>3.45 = Fertilization treatments × cultivar | | | |

### 2. wheat yield

The impact of applying gibberellic acid and a mixture of microelements and balanced mineral fertilizer on the weight of a thousand grains during the Al-Qadisiyah province location in season 2021–2022 is displayed in Table 6. The weight of a thousand grains varied significantly depending on which fertilization treatment was used. For example, in the Baghdad 3 cultivar, the weight of a thousand grains increased to 40 g and 43.11 g for the T2 and T3 treatments, respectively, whereas it only reached 35.62 g for the T1 treatment. When compared to the T1 (30 g) fertilization treatment, the weight of 1000 grains for the Babylon 113 cultivar rose with the T2 (34 g) and T3 (37.52 g) fertilization treatments. When compared to T1 (25.20 g) fertilization treatments, the weight of 1000 grains in the Al-Furat cultivar rose with T2 (32.12 g) and T3 (36.35 g) treatments. The average weight of 1000 grains varied significantly across cultivars, according to the data. The Baghdad 3 cultivar had the greatest average weight of 1000 grains (39.58) g, while the Al-Furat cultivar had the lowest average (31.22) g, indicating a fall in an average of 21.12%. Table (6) also illustrates the impact of micro-elements and a balanced mineral fertilizer combination on the overall wheat production in the Al-Qadisiyah province during the 2021–2022 growing season. It is observed that the various fertilization procedures result in notable variations in the overall yield. In comparison to the T1 treatment (2664 kg ha$^{-1}$) in the Baghdad 3 cultivar, the total wheat yield attained (3900 kg ha$^{-1}$) and (3664 kg ha$^{-1}$) during the T2 and T3 fertilization treatments, respectively. Comparing the Babel 113 cultivar to a T1 fertilization treatment (2500 kg ha$^{-1}$), the weight enhanced the total yield with fertilization treatments T2 (3664 kg ha$^{-1}$) and T3 (3920 kg ha$^{-1}$). When compared to treatment T1 (1832 kg ha$^{-1}$), the total wheat yield in the Al-Furat cultivar rose with fertilization treatments T2 (2500 kg ha$^{-1}$) and T3 (3460 kg ha$^{-1}$) (Ati and Dawod, 2024, Ati *et al*., 2024) The results also demonstrated notable variations in the average weight of the total wheat yield among the cultivars. The Baghdad 3 cultivar had the highest mean of the total wheat yield (3409 kg ha-1) compared to the Al-Furat cultivar, which had the lowest average (2597 kg ha$^{-1}$) with an average decrease of 23.82%.

**Table 6.** The effect of spraying with gibberellic acid and a balanced mineral fertilizer on the weight of 1000 grains (g), the total yield (kg ha$^{-1}$) and water productivity (kg m$^{-3}$)

| Cultivar | Treatments | 1000 grain | Total yield | Water productivity |
|---|---|---|---|---|

| | | **weight (g)** | **kg ha$^{-1}$** | **kg m$^{-3}$** |
|---|---|---|---|---|
| **Bagdad 3** | **$T_1$** | 35.62 | 2664 | 0.63 |
| | **$T_2$** | 40.00 | 3664 | 0.86 |
| | **$T_3$** | 43.11 | 3900 | 0.92 |
| **Mean** | | 39.58 | 3409 | 0.80 |
| **Babylon 113** | **$T_1$** | 30.00 | 2500 | 0.59 |
| | **$T_2$** | 34.00 | 3664 | 0.86 |
| | **$T_3$** | 37.52 | 3920 | 0.92 |
| **Mean** | | 33.84 | 3361 | 0.79 |
| **Al-Furat** | **$T_1$** | 25.20 | 1832 | 0.43 |
| | **$T_2$** | 32.12 | 2500 | 0.59 |
| | **$T_3$** | 36.35 | 3460 | 0.81 |
| **Mean** | | 31.22 | 2597 | 0.61 |
| **LSD 0.05 cultivar × Fertilization treatments** | | 5.11 | 260.56 | 0.21 |
| **LSD 0.05cultivar** | | 4.45 | 180.55 | 0.16 |
| **LSD 0.05Fertilization treatments** | | 3.12 | 231.15 | 0.13 |

The present study showed all results of (Tables 3, 4, 5 and 6), it is noted that the level of gibberellin had a significant effect on the characteristics of plant height and leaf area. Also, gibberellin helped to collect chlorophyll, which maintains decarboxylase in leaves, because gibberellin is a protector of chlorophyll enzyme, or gibberellin led to an increase in nitrogen concentration in scientific leafs and because the chlorophyll molecule consists of four nitrogen atoms and thus led to an increase in chlorophyll content (Sharif et al., 2020). The increase in the average of the characteristics of spike length and weight of a thousand grains was reflected in the total yield of wheat, and perhaps the reason is that the gibberellin delayed the development of the middle spikelet's in the spike, which provided sufficient time for the terminal spikelet's to reach a similar developmental stage, which resulted in a more symmetrical development for all spikelet's in the spike. Hence, the reason for producing more grains in the spike, Gibberellins also helped in the absorption of nutrients in the plant (Alhaidary and Ahmed,2017 ,AL-Obaidy,2015 and Rawa et al., 2016; Ati and Hamed Hamed, 2024) The results of the study also showed that the treatments of foliar fertilization spraying with Macro and Micro elements had significant differences compared to the control treatment in most of the studied phenotypic and productive properties. These increases can be attributed to the roles of micro-elements added by spraying solutions in many physiological processes, such as increasing the chlorophyll content in leaves, which is necessary to raise the efficiency of the photosynthesis process, and the formation of the amino acid Tryptophan, which is necessary for cell elongation, The active role of iron, copper, zinc and manganese elements in activating the processes of nutrient absorption, including nitrogen, phosphorous, potassium, iron, copper and zinc in plants, and the formation of amino acids, carbohydrates and energy compounds, and increasing the processes of respiration and photosynthesis in plants, is also evident (Daher et al., 2020) This confirms the importance of adding Macro and Micro elements in balanced quantities so that the absorption of some of them does not affect others, and from here it becomes clear that adding micro nutrients in balanced quantities with major elements may ensure achieving a state of balance in the plant that leads to improving its growth and yield quantitatively and qualitatively. In this study, the Macro and Micronutrients were given on four foliar fertilizing sprays during the growing season, which allowed the plant to absorb the largest possible amount of the element in each batch (Ati et al., 2019). This confirms that the effect of spraying on the leaves is more effective in case of deficiency of Macro and Micro elements such as zinc, copper and iron, due to the nutrient balance in the vegetative part when spraying, which led to stimulating the plant to absorb the elements from the soil to create a nutritional balance between them. The difference in the cultivar of the crop has a significant effect on the properties of the yield, where the genetic composition has an important role in the accumulation of dry matter through its effect on growth indicators, which leads to the effect on the weight of the bean and the speed of its growth, which are determined by the genetic factor with the effect of other growth factors. Also, the difference in genetic composition affects the ability to produce the components of the crop (the weight of 1000 seeds and the yield of grains), where it leads to a difference in number and weight according to the genetic nature and the available growth factors. Table (6) shows the effect of spraying with gibberellic acid and the fertilizer combination (balanced mineral fertilizer and microelements) during season 2021/2022 and the type of wheat crop on water productivity (kg m-3). We note that the water productivity of T3 fertilization treatment was 0.92 kg m-3, 0.92 kg m-3 and 0.81 kg m-3 at Baghdad 3, Babylon 113 and AL-Furat, respectively. The Baghdad 3 cultivar was excelled by giving the highest water productivity of 0.80 kg.m-3, then Babel 113 with a water productivity of 0.79 kg.m-3 and the Euphrates at 0.61 kg.m-3. The plant cultivar influences water productivity, due to the significant increase in the yield of the Baghdad 3 cultivar, compared to the other two cultivars.

## Recommendations

1. Raising awareness of farmers about moving towards the use of foliar feeding as spraying on plants for major and minor elements, as it is an important tool in agricultural research to investigate hypotheses before making agricultural decisions by extending it with an integrated package of fertilizer operations in order to reach the highest productivity of yield, which saves a lot of time, effort and money.

2. Proposing the cultivation of varieties with a genetic structure that resist climatic changes to give the highest yield.

3. Several studies should be prepared on other agricultural practices such as the appropriate planting date along with the onset and cessation of rains, seasonal droughts and optimum fertility level in crop yield.

## References

**AL-Ghanimy, R. H. 2015**. The impact of Irrigation with Salin water and Foliar application of Gebberellin on growth of Wheat plant. A Thesis master’s degree in biology / University of Karbala.

**Alhaidary, H. and H. Ahmed. 2017**. EFFECT OF WATER SALINITY GIBBERELLIC ACID ON LEAF AREA AND COMPENET WHEAT YIELD. Diyala Journal for Agricultural Sciences. 9 (2): 146-157.

**Allen, R.; L. Pereira; D. Raes and M. Smith. 1998**. Crop Evapotranspiration. FAO Irrigation and Drainage. Rome. Leaf 65.

**Al-Mohammedi, O.H., AL-Sahaf, F. and Ati, A.S., 2019**. Effect of organic, chemical fertilization and whey and on vegetative growth of potatoes cv Desiree. *Journal of Kerbala for Agricultural Sciences, 1*(1), pp.65-81.

**AL-Obaidy, B. S. 2015.** Wheat Triticum aestivum L. Seed Priming for Drought Tolerance. Ph. D. of Doctor of Philosophy in Field Crops Sciences (crop physiology) of Agriculture at the University of Baghdad.

**Ati, A. S. and Hamed MS. 2024**. Soil Quality and Health. Advances in Agricultural Technology & Plant Sciences. 7 (2): 180159.

**Ati, A.S. and Dawod, S.S., 2024**, July. Strategy for Management of Using Saline Irrigation Water and Tillage Systems in Water Productivity and Wheat. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1371, No. 8, p. 082040). IOP Publishing.

**Ati, A.S., Al-Hilfy, I.H. and Mehdi, A.H., 2021**. Effect of Drought Stress (Water Deficit) and Plant Density on Productivity of Water and Zea mays (Baghdad Varieties) in Middle Region of Iraq. *Kirkuk University Journal for Agricultural Sciences (KUJAS)*, *12*(2) Appendix).

**Ati, A.S., Majeed, S.S. and Mahdee, H.S., 2024**. Determining the Productivity of Water and Wheat Using AquaCrop Model under the Fixed Sprinkler Irrigation System in Basrah Governorate/Al-Luhais Region. *Dijlah Journal of Agricultural Sciences*, *2*(2), pp.212-224.

**Ati, A.S., S. Abdul-Jabbar, A. Hamad Hassan, and R. Fakhry Musa. 2019.** The role of incomplete irrigation scheduling and biofertilizers in water and wheat productivity in central Iraq. Kirkuk University Journal of Agricultural Sciences. (1). 661-669.

**Ati, Alaa Salih, Kadhim Dealy Hassan, and Kadhim Makee Naser. 2018.** "Effect of Intercropped and Micronutrient Fertilizers for Cucurbita pepo L. and Cucumis sativus L. on Water Productivity and Yield Under Drip Irrigation System. " *Journal of Kerbala for Agricultural Sciences*, 5 (2018): 30-37.

**Black, C. 1965**. Methods of soil analysis. Am. Soc. Agron. No. 9 part 1. Madison, USA.

**Daher, M., M. Darwish and S. Haifa. 2020.** Effect of Gibberellic Acid (GA3) and Balanced Fertilization (NPK) on Some Productive and Quality Characteristics in Sweet Corn (*Zea mays* var. *saccharata*) (*Merit Hybrid*) Under Salt Stress. *Syrian Journal of Agricultural Research – SJAR 7(3): 259-278 June 2020.*

**Dawod, S.S., A.S. Ati, and I.A. Abdujabbar, 2024**. Management of using saline irrigation water and tillage systems on the soil mechanical and hydraulic. Iraqi Journal of Agricultural Sciences 55(6): p.2050-2059.

**Jabbar, H.A., Ati, A.S. and Hassan, A.H., 2020**. FURROW IRRIGATED RAISED BED (FIRB) TECHNIQUE FOR IMPROVING WATER PRODUCTIVITY IN IRAQ. *Plant Archives*, *20*(2), pp.1017-1022.

**Kumar, V., R. Naresh, S. Kumar, S. Kumar, A. Kumar, R. Gupta, and N. Mahajan. 2018.** Efficient Nutrient Management Practices for Sustaining Soil Health and Improving Rice-Wheat Productivity: A Review. *Journal of Pharmacognosy and Phytochemistry*. 7(1): 585-597.

**Mahdee, H.S., Ati, A.S. and Rahim, B.R., 2023,** December. Role of Clay Minerals on Saturated Hydraulic Conductivity in Different Region of Iraq. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1262, No. 8, p. 082006). IOP Publishing.

**Mahmoud, S.H., Ati, A.S. and Majeed, S.S., 2024, July**. Calculating Water Productivity Using the Portal WaPOR. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1371, No. 8, p. 082039). IOP Publishing.

**Page, A.L.; R.H. Miller and D.R. Keeny. 1982**. Methods of Soil Analysis part 2nd (Ed). Madison Wisconsin. USA. Agro. 9.

**Rawa, Al Babele, B. Abo Trabi, M. Jabour and R. Morshed. 2016**. Effect of foliar spraying with some natural extracts and GA3on the growth and seed production of onion. Dimashq Journal. 32 (1):185-200.

**SAS. 2018**. Users Guide. Statistics. SAS. Inst., Cary, N. C., USA.

**Sharif, Yaseen Obaid Noori Ahmed, Al Jubori, Jassim Mohamed Aziz. 2020.** Effect of Plant Density and Organic Fertilizers on Growth and Yield of Pop Corn (Z*ea mays* L. everta) Kirkuk University Journal for Agricultural Sciences (KUJAS) 11:126-143.

**Thomas, H. 1975**. The growth response to weather stimulated vegetative swards of a single genotype of lolium perenne. J. Agric. Sci. comb. 84: 333-343.